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(54) Metering apparatus

(57) Metering apparatus, in particular for agricultural distribution machines, is provided with one or more metering elements (5) intermittently drivable by a freewheel device (27). The freewheel device comprises a projection (30) engageable with an eccentric member (26) mounted on a drive shaft (10) and the stroke of the projection is variable by adjustment of the eccentric (26) about a pivot (34). Precise adjustment is facilitated by two mutually abutting scales (40, 41) wherein the spacing between the individual division lines of the one scale (41) is smaller by the fraction of this spacing resulting from their number, than the spacing between the corresponding division lines of the other scale (40). An alternative arrangement has a non-adjustable, two lobed cam in place of the eccentric, and an adjustable stop coacting with the cam follower.

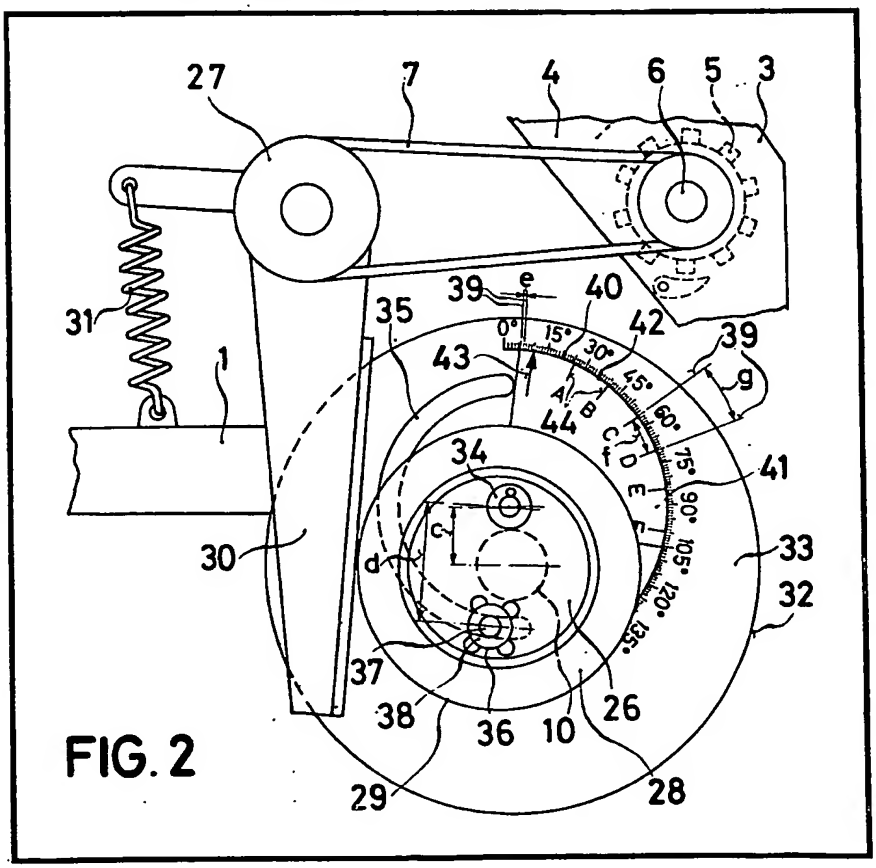

FIG. 2

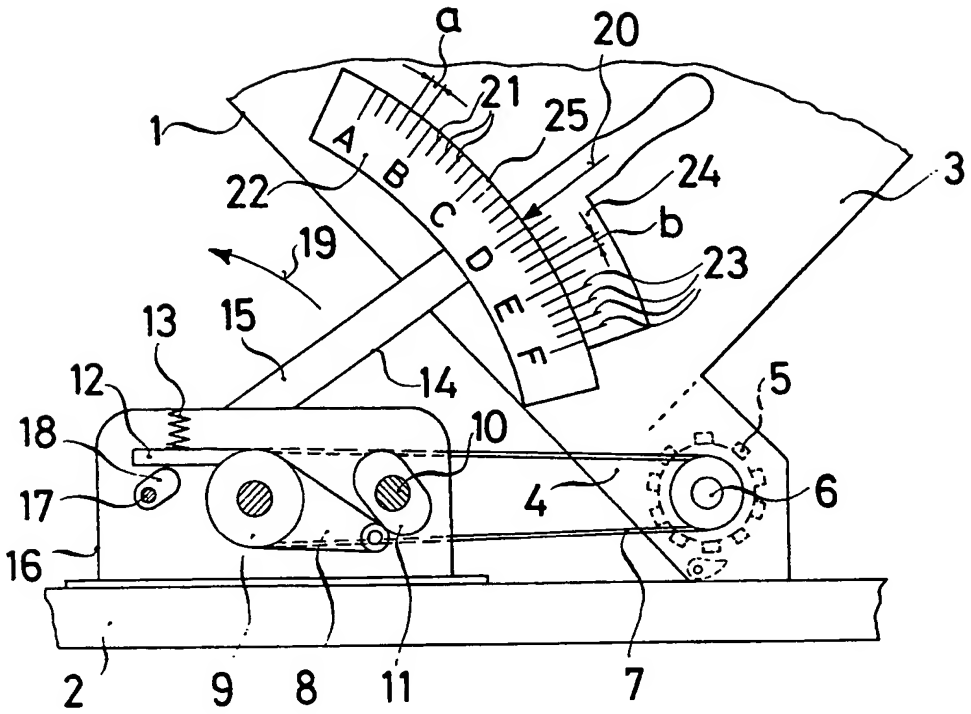

FIG. 1

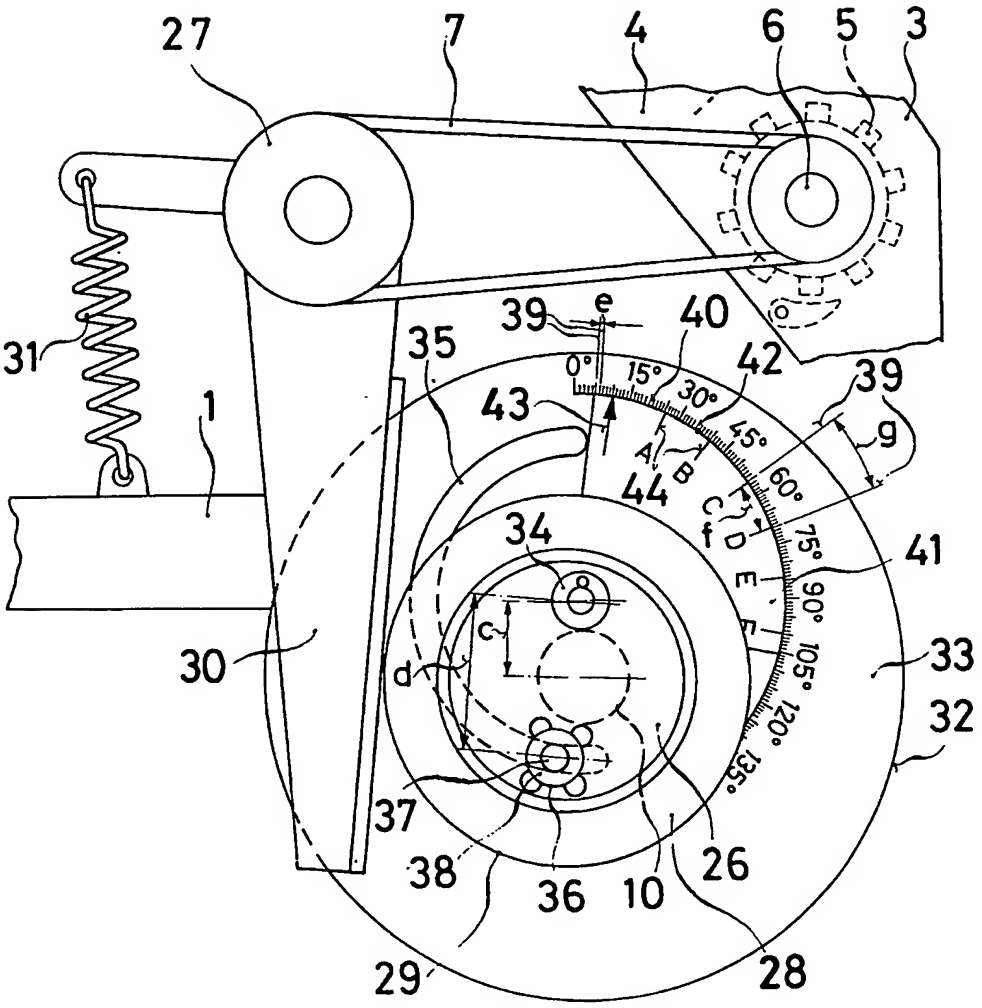
27
7
4
6
5
3
31
1
35
39
e
40
42
43
0°
15°
30°
45°
60°
75°
90°
105°
120°
135°
A
B
C
D
E
F
f
g
44
34
41
C
d
30
33
32
37
38
36
10
26
29
28

FIG. 2

SPECIFICATION

Metering apparatus

The invention relates to metering apparatus, and particularly but not exclusively to such apparatus for use in agricultural distribution machines.

A metering device is known (see DE-PS 22 38 328) which comprises a metering element intermittently drivable by a freewheel device. The freewheel device has a projection which is resiliently engageable with an eccentric member connected to a driving shaft and the movement of which is rendered reciprocatory by its engagement with the eccentric member and is adjustable, as to the magnitude of its stroke, by an adjusting device which comprises an actuator element co-operating by means of a marking with a single scale subdivided by uniformly spaced division lines.

This metering apparatus has already stood the test in practice. However, it has the disadvantage that small distribution quantities, such as are required for fertilisers containing a high percentage of foodstuffs, or even in particular for herbicides, insecticides and fungicides in the form of micro-granulates, cannot be adjusted with the necessary accuracy.

The invention provides metering apparatus comprising a drive shaft having an eccentric member mounted thereon, at least one metering element, a freewheel device for intermittently driving the metering element and having a projection which is resiliently biassed towards engagement with the eccentric member so as to be rendered reciprocatory when engaged by the eccentric member during rotation of the drive shaft, and adjusting means for varying the stroke magnitude of the projection during reciprocatory movement thereof, said adjusting means including first and second abutting, relatively movable scales, one of which is a main graduated scale and the other of which is a vernier scale enabling readings on the main scale to be made to a fraction of a division.

The invention also provides metering apparatus comprising at least one metering element which is intermittently drivable by a freewheel device having a projection which is resiliently engageable with an eccentric member connected to a drive shaft and movement of which is rendered reciprocatory owing to its engagement with the eccentric member, the magnitude of its stroke being variable by means of an adjusting device which comprises an actuator element co-operating with a first scale by way of a marking, the first scale being sub-divided by division lines which are arranged at mutually uniform spacings and the marking being abutted by a second scale provided with division lines which are arranged relatively to each other at uniform spacings wherein each spacing between the division lines of the second scale at its abutment edge with the first cable is smaller by a fraction, resulting from their number, of the spacing of the division lines on the first scale, than the spacing of the corresponding division lines on the first scale.

Thus, for adjustment of the distribution quantity, initially merely the marking must be moved to coincide with the division line of the first scale corresponding approximately to the distribution quantity whereafter the marking is moved further in the direction of the respective next following division line of the first scale to such an extent that the division line of the second scale corresponding to the desired pitch spacing between the two division lines of the first scale is exactly in line with a division line of the first scale. Owing to a special characterisation of the division lines on the first and second scales, it is additionally possible to produce tables of the adjustments available for the appropriate distribution quantities for the individual kinds of material and, starting from this table to adjust accurately the respective desired or required distribution quantity by means of the metering apparatus.

Preferably, the eccentric member is surrounded by a bearing having an outer jacket is arranged on a plate fixed on the driving shaft and, in respect of its eccentricity relatively to the driving shaft is steplessly adjustable by means of a guide slot provided in the plate as well as a clamping device, and the first scale is located on said plate, the second scale is located at the outer jacket of the bearing. In this case the guide slot and the scales may be of rectilinear or arcuate construction.

The metering apparatus may thus excel due to the fact that the projection of the freewheel device is located at the outer jacket of the eccentric member in uninterrupted engagement therewith during each adjustment of its reciprocatory swinging stroke movement and during the entire distribution operation. As a result thereof a completely shock-free movement of the metering element or elements intermittently driven by the freewheel device is obtained, so that also the adjustment accuracy of the distribution quantities is increased further.

Desirably, the eccentric member is pivotally mounted on the plate the guide slot extends concentrically about the pivot axis of the eccentric member over a range of at least 180°, and the first scale is likewise arranged to extend concentrically about the pivot axis of the eccentric member over a range of 180°, whereas the second scale abuts the first scale and is guided parallel thereto over a range of 89°. The second scale may be divided into six spacings of equal magnitude.

Advantageously, the division lines of the first scale have a mutual spacing which corre-

sponds to an angle of 1° and the division lines of the second scale have a mutual spacing which corresponds to an angle of 14°50'.

Thus, not only easily performable instructions for the utilisation of the adjusting device can be provided but, moreover, at least a doubling of the accurate adjustment possibilities for distribution quantities is permitted. Stated differently the jumps between the accurately adjustable distribution quantities may furthermore be halved. This halving is so performed in practice that a division line of the second scale is located on one side closely adjacent a division line of the first scale and the next following division line of the second scale is located on the other side at the same spacing closely adjacent another division line of the first scale.

The invention will now be more particularly described with reference to the accompanying drawings, wherein:

Figure 1 is a side view of one embodiment of a metering apparatus according to the invention;

Figure 2 is a side view on a different scale of another embodiment of a metering apparatus according to the invention.

Referring to Fig. 1, the metering apparatus shown therein is mounted on an agricultural distribution machine 1 which comprises a frame 2 (only partially illustrated) and a storage container 3. The lower region of the container 3 has a plurality of outlet openings 4 arranged in a row. The metering apparatus comprises metering elements 5 in the form of feeder wheels which are mounted on a common shaft 6 and each of which is located in front of a respective outlet opening 4. The shaft 6 with the metering elements 5 is driven by a power source in a known manner not illustrated by way of a chain drive 7, a freewheel device 9 provided with a projection 8 and an eccentric member 11 connected to the driving shaft 10 and constructed in the form of a twin eccentric member. The power source may consist of a running wheel of the distributor machine, or a motor.

The freewheel device 9 is fitted additionally with an attachment 12 upon which operates a resilient element 13 in the form of a compression spring and, by way of the freewheel device 9, exerts a force upon the projection 8 in the direction of the abutment thereof against the eccentric member 11. Thus, the projection 8 is caused to undergo reciprocatory swinging stroke motion during the rotation of the driving shaft 10. The frequency of this motion is twice the speed of rotation of the driving shaft 10, and the freewheel device 9 transmits the motion intermittently in one direction by means of the chain drive 7 to the shaft 6 and thus to the metering elements 5. From these metering elements 5, material which flows out of the outlet openings 4 and which may consist of fertilisers, micro-granulates or even seeds, may then be conveyed to a distribution apparatus in a known manner not illustrated and distributed thereby over the ground surface or introduced into the ground by means of share blades.

In order to be able to vary the reciprocatory swinging stroke movement of the projections 8 and thus the rotary speed of the metering elements 5 and, by way of the latter, in turn, the distribution quantities of the material to be distributed, the metering device 14 comprises an adjustment device 14. This adjustment device 14 includes an actuator element 15 constructed as a lever which is fixed to and projects from a shaft 17, the latter being located below the attachment 12 and rotatably mounted in a housing 16. Furthermore, a cam 18 is mounted on the shaft 17 with its free end in abutting engagement with the attachment 12.

When then the actuator element 15 is swung in the direction of the arrow 19, the attachment 12 is raised by the cam 18 against the influence of the resilient element 13, whereby the projection 8 is moved away from the eccentric member 11 to a certain extent. As a result thereof, the eccentric member 11 in co-operation with the resilient element 13 can swing the projection 8 to and fro with only a correspondingly smaller stroke, whereby also the rotary motion of the metering elements 5 and thus the distribution quantity is reduced. If the pivotal movement of the actuator element 15 is effected in the direction of the arrow 19 to such an extent that the projection 8 does not come at all into contact with the eccentric member 11 any more, the metering elements 5 come to standstill and no distribution of material takes place. In contrast, when the actuator element 15 is swung in the opposite direction of the arrow 19, an increase of the reciprocatory swinging stroke motion of the projection 8 results, until its stroke attains its maximum value with uninterrupted abutting engagement with the eccentric member 11 at which the maximally adjustable distribution quantity is obtained.

In order that this distribution quantity may even be adjusted accurately with reference to a table, the actuator element 15 is provided with a marking 20, and a first scale 22 in the form of a maingraduated scale arranged on a storage container 3, the scale 22 being divided into mutually uniform spacings *a* by means of the division lines 21. For facilitating the adjustment, the first one of the division lines 21 which represents the so-called zero position in which no material is conveyed by the metering elements 5, is clearly marked by the letter A, and each subsequent fifth division line 21 is denoted by one of the letters B to F in uninterrupted succession. Furthermore, the marking 20 is included in a scale 24 in the form of a vernier scale which is divided

into ten spacings *b* of equal magnitude by means of the division lines 23. At the abutting edge 25 between the second scale 24 and the first scale 22, this spacing *b* is then smaller than the spacing *a* between two corresponding division lines 21 of the first scale 22, by a fraction which results from the number of spacings *b* on the second scale 24, i.e. by 1/10. Thus, the actuator element 15 can be adjusted in a simple manner to 1/10 of the spacing *a* between two division lines 21 of the first scale 22.

For the purpose of characterising the adjustment of the metering apparatus which corresponds to a certain distribution quantity, it is only necessary to state in the table the corresponding letter, the subsequent number of division lines 21 on the first scale following after the letter, and the division line 23 on the second scale 24 which must be brought to accurately coincide with any one division line 21 of the first scale. In the embodiment as illustrated in Fig. 1, the denomination C 43 is stated in the table for the appropriate distribution quantity, this denomination signifying that the marking 20 must be located so far behind the fourth division line 21 of the division line 21 characterised by the letter C of the first scale 22, that the third division line 23 of the second scale 24 is accurately in line with a division line 21 of the first scale 22.

In the constructional example illustrated in Fig. 2, the metering apparatus is located on an identical distribution machine 1 and again comprises the metering elements 5 which are arranged in front of each outlet opening 4 of the storage container 3 of this machine, on the common shaft 6. The metering elements 5 are driven by a power source not illustrated by way of a driving shaft 10, an eccentric member 26, a freewheel device 27 and a chain drive 7. In this case the eccentric member 26 has a bearing 28 which surrounds it. A projection 30 of the freewheel device 26 is held in continuous abutment with the outer jacket 29 of the bearing 28 by means of a resilient element 31 which is constructed in the form of a tension spring.

The most essential difference between this embodiment and the metering apparatus as shown in Fig. 1 resides in that an adjustment device 32 comprises a plate 33 which is fixed to the driving shaft 10 and on which the eccentric member 26 is mounted for angular movement about a pivot bearing 34, its eccentricity in relation to the driving shaft 10 being steplessly adjustable by means of a semicircular cam guide slot 35 in the plate 33 and arranged concentric with the pivot bearing 34, and a clamping device 36. In this case the clamping device 36 comprises a screw-threaded bolt 37 extending through the cam guide slot 35, and a screwthreaded clamping nut 38.

When then the clamping device 36 is located at the lower end of the cam guide slot 35, the eccentric member 26 is centred relatively to the driving shaft 10, so that its eccentricity is equal to zero, and the metering element 5 remains at standstill even with the driving shaft 10 rotating. When, however, the clamping device 36 is located at the upper end of the cam guide slot 35 which extends over an arc of 180°, a maximum eccentricity of the eccentric member 26 is produced which is as large as the sum of spacing *c* of the pivot bearing 34 from the driving shaft 10 and spacing *d* between the pivot bearing 34 and the bolt 37 of the clamping device 35.

For the purpose of characterising this large adjustment range, a first arcuate scale 40 in the form of a main graduated scale is disposed on the plate 33 concentric with the pivot bearing 34, the scale 40 being divided into equal spacings *e* by means of the division lines 39. In this case this spacing *e* corresponds exactly to an angle of 1° and the first scale 40 extends over a range of 180°. Abutting the first scale, a second arcute scale 41 is in the form of a vernier scale located at the outer jacket 29 of the bearing 28. The scale 41 extends parallel to the first scale 40 over a range of 89° and is divided at its abutting edge 42 with the first scale 40 into six spacings *f* of equal size by a marking 43 and division lines 44. In this case the spacing *f* is smaller, by the fraction resulting from the number of these spacings *f*, that is to say 1/6 or, expressed in terms of the angle, by 10′ then a spacing *g* corresponding to this spacing *f*, of fifteen spacings *e*, on the first scale 40. Furthermore the division lines 44 are characterised by the letters A to F.

As a result of this division, only one adjustment is obtained for each division line 39 of the first scale 41, which is in line with one of the division lines 44 characterised by the letters A to F, of the second scale 41. In the embodiment as illustrated in Fig. 2, the second scale 41 is located relatively to the first scale 40 in a position such that the seventieth division line 39 thereof, which with the division line for the zero position includes an angle of 70°, is in line with the division line 44 of the second scale 41 denoted by the letter D. Thereby an angular displacement of 10°40′ is obtained for the eccentric member 26 about the pivot bearing 34 thereof. For this adjustment corresponding to the distribution quantity it is only necessary then to state the characterisation D 70 in a tabular arrangement.

At the smallest adjustment of A 15 to be characterised by a letter and a whole number, the eccentric member 26 would be angularly displaced about its pivot bearing 34 by an angle of 10′.

CLAIMS

1. Metering apparatus comprising a drive shaft having an eccentric member mounted thereon, at least one metering element, a freewheel device for intermittently driving the metering element and having a projection which is resiliently biassed towards engagement with the eccentric member so as to be rendered reciprocatory when engaged by the eccentric member during rotation of the drive shaft, and adjusting means for varying the stroke magnitude of the projection during reciprocatory movement thereof, said adjusting means including first and second abutting, relatively movable scales, one of which is a main graduated scale and the other of which is a vernier scale enabling readings on the main scale to be made to a fraction of a division.

2. Metering apparatus comprising at least one metering element which is intermittently drivable by a freewheel device having a projection which is resiliently engageable with an eccentric member connected to a drive shaft and movement of which is rendered reciprocatory owing to its engagement with the eccentric member, the magnitude of its stroke being variable by means of an adjusting device which comprises an actuator element co-operating with a first scale by way of a marking, the first scale being sub-divided by division lines which are arranged at mutually uniform spacings and the marking being abutted by a second scale provided with division lines which are arranged relatively to each other at uniform spacings, wherein each spacing between the division lines of the second scale at its abutment edge with the first scale is smaller by a fraction, resulting from their number, of the spacing of the division lines on the first scale, than the spacing of the corresponding division lines on the first scale.

3. Metering apparatus as claimed in claim 1 or 2, wherein the eccentric member is surrounded by a bearing having an outer jacket, is arranged on a plate fixed on the driving shaft and, in respect of its eccentricity relatively to the driving shaft is steplessly adjustable by means of a guide slot provided in the plate as well as a clamping device, and wherein the first scale is located on said plate, the second scale is located at the outer jacket of the bearing.

4. Metering apparatus as claimed in claim 3, wherein the eccentric member is pivotally mounted on the plate, the guide slot extends concentrically about the pivot axis of the eccentric member over a range of at least 180°, and the first scale is likewise arranged to extend concentrically about the pivot axis of the eccentric member over a range of 180°, whereas the second scale abuts the first scale and is guided parallel thereto over a range of 89°.

5. Metering apparatus as claimed in claim 4, wherein the second scale is divided into six spacings of equal magnitude.

6. Metering apparatus as claimed in anyone of claims 2 to 5, wherein the division lines of the first scale have a mutual spacing which corresponds to an angle of 1° and the division lines of the second scale have a mutual spacing which corresponds to an angle of 14°50′.

7. Metering apparatus substantially as herein described with reference to and as shown in Fig. 1 or Fig. 2 of the drawings.

8. An agricultural distribution machine comprising metering apparatus as claimed in anyone of the preceding claims.

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